INSPIRING **SCIENCE MAGAZINE** FOR GIRLS. FUN READING FOR ALL. **SUMMER 2023**

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Glow in the dark

Exploring the mysteries of bioluminescent algae

DNA Hunting in the Jungle with

Mrinalini Erkenswick Watsa

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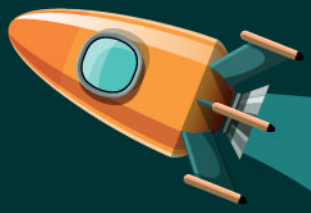

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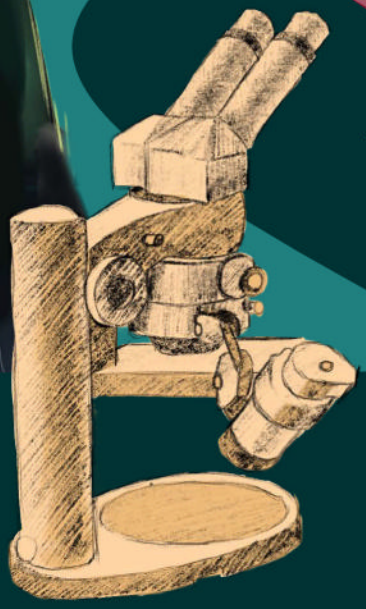
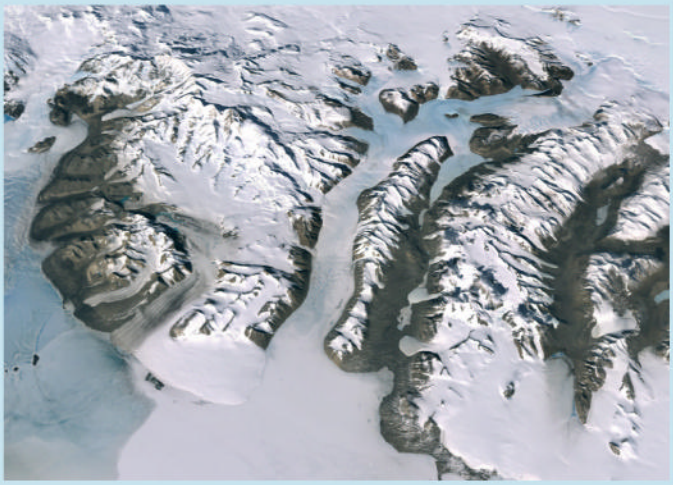


#1 Stable patches of ice
fix themselves in Antarctica

Although global warming has caused a lot of Antarctic ice to melt, contributing to rising sea levels, large patches of ice in West Antarctica remain stable. A team of scientists explored one such stable region, known as the Kamb Ice Stream.



Certain Antarctic glaciers are healing and filling up crevices with ice, says a report.

The team found grooves and ripples on the underside of the ice, and as planetary scientist Justin Lawrence reports, this indicates a fine balance of temperature in these areas. The balance between freezing and melting temperatures does not tip there, causing the ice to form shapes that are akin to mineral deposition in limestone caves. This process is also fixing massive crevices in the Kamb Ice Stream. Elsewhere, at Thwaites Glacier in Antarctica, these crevices are regions where ice melts faster. The results from the exploration of the Kamb Ice Stream provide a glimmer of hope amidst the usual stories of crisis that Global Warming brings about.

Credit: NASA on The Commons via Wikimedia Commons

#3 Terminator zones
how we might find life on distant planets

Astronomers at the University of California have described how life might exist on distant planets where there is permanent day on one side and permanent night on the other. A special zone, dubbed a “terminator zone,” forms a ring on the planet. What's special about this ring is that it has two zones of its own—one that faces the sun, while the other one faces away. This dark

#2
A quake
in the universe?

Scientists have recorded a ripple across the universe for the first time. A shock wave cast a faint glow in the wake of an event that hurled charged particles along the magnetic fields of the universe. Radio telescopes picked up this glow and detected the shockwaves.

Usually, these shockwaves are caused when galaxies merge and gaseous filaments existing between galaxies collide. The shockwaves in galaxies are routinely detectable; however, shocks in filaments have never been seen, until now. These quakes push charged particles along magnetic fields, and the event generates light that is picked up by radio telescopes. The interaction of these particles with the magnetic field will fuel further insight into the origin of magnetic fields in the universe.

A radio telescope in action

Credit: CSIRO via Wikimedia Commons

Credit: ESA/Hubble, M. Kornmesser via Wikimedia Commons

A planet with permanent night and day might have a midway zone suited for life.

zone might be habitable, suggest the scientists. The terminator region is the region practically caught in the middle between day and night, and has temperatures that are neither too hot nor too cold. Considering such a planet with low rotation speed, life might have a chance at sprouting in distant specks in space.

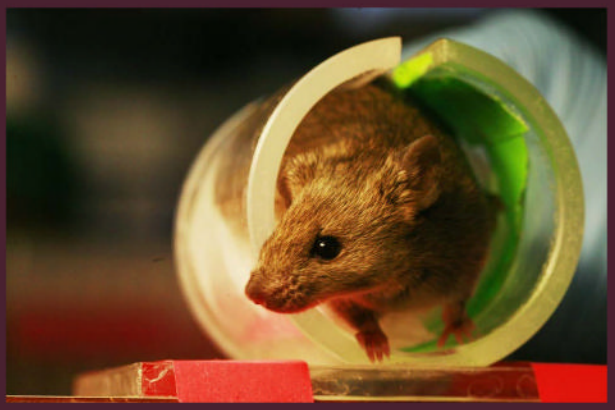
#Earth Science

Meteorites aren't the secret to how Earth got so much water

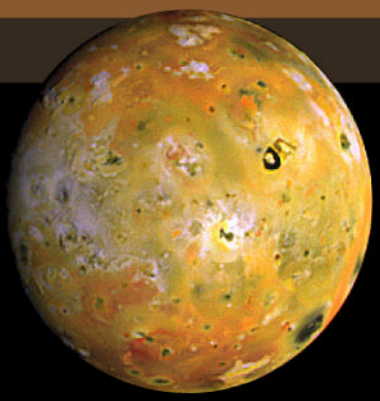
Meteorites on Earth are not secret to our waters, says a new study.

When and how did Earth get to be 71% water? There are hardly any answers to this question, and none of them are convincing, either. One such hypothesis claims that the water that we find on Earth comes from outer space, especially on asteroids. However, researchers at the University of Maryland claim otherwise. In a process called melting, meteorites almost the size of a planet heat up and form different layers. This new research notes that once a meteorite melts, there is no more water left in the meteorite. The water content in these meteorites is just two-millionths of the total mass, which is certainly not enough to cover almost an entire planet with water.

A thirsty tomato vine may ask for water, but we aren't particularly good at hearing those cries.



Diving "head first" into research on anxiety.



Io perhaps could have been a second Earth if it wasn't dried to a crisp by young Jupiter.

#Space

Young Jupiter was ten thousand times brighter and might have dried out its moon

Jupiter is one of the brightest planets in the solar system. The gas giant was ten thousand times brighter when it was younger. The ancient radiance might have vaporized any water on the glorious icy moons of Jupiter. The moons Io, Ganymede, Europa, and Callisto faced the inescapable heat of this brightness, and the water on these moons ultimately dried out. One crucial trend involves the moons being icier and colder the farther they are from Jupiter. The icy moon of Io might have had a temperature of around 26°C for the first few million years. Who knows; Io might have been a second Earth if Jupiter wasn't so bright.

#Botany

Would you fancy some water while we talk, Tomato?

When thirsty, a tomato plant might literally be letting out a cry for water. In a report published in the journal *Cell*, evolutionary scientists talk about distinct sounds that dry tomato and tobacco plants make. The same sounds occurred when the researchers snipped a stem of the plant. The sounds are ultrasonic "clicks," much like the ultrasonic sound that bats use to echolocate. We humans cannot pick up these sounds, but dogs can. A thirsty tomato plant generated 35 clicks every minute. With further research, farmers might have a new method to know when their crops are stressed and thirsty. All they would need are microphones that pick up these ultrasounds.

Credit: ESA/Hubble, M. Kornmesser via Wikimedia Commons

#Neurosciences

Where does anxiety start; the head or the heart?

Sometimes it is better to listen to the heart than to the brain. In new research, scientists found that a higher heart rate in mice can induce anxiety. Using genetically engineered mice and tiny vests with red light, they were able to manipulate the heart rates of the mice. They observed that the mice would lurk in corners and crawl along walls, all of which are signs of anxiety in mice. Next, the scientists located the part of the brain that responded to the increased heart rate. The obvious question cropped up: can anxiety be switched off? With some more gene play, the scientists numbed the response system in the brain. Now the mice had a racing heart, but no anxiety. This study opens up a new avenue for treating panic and anxiety.

Credit: JS via Wikimedia Commons

Credit: Rama via Wikimedia Commons

#Zoology

Transparent fish become rainbow-colored; but why?

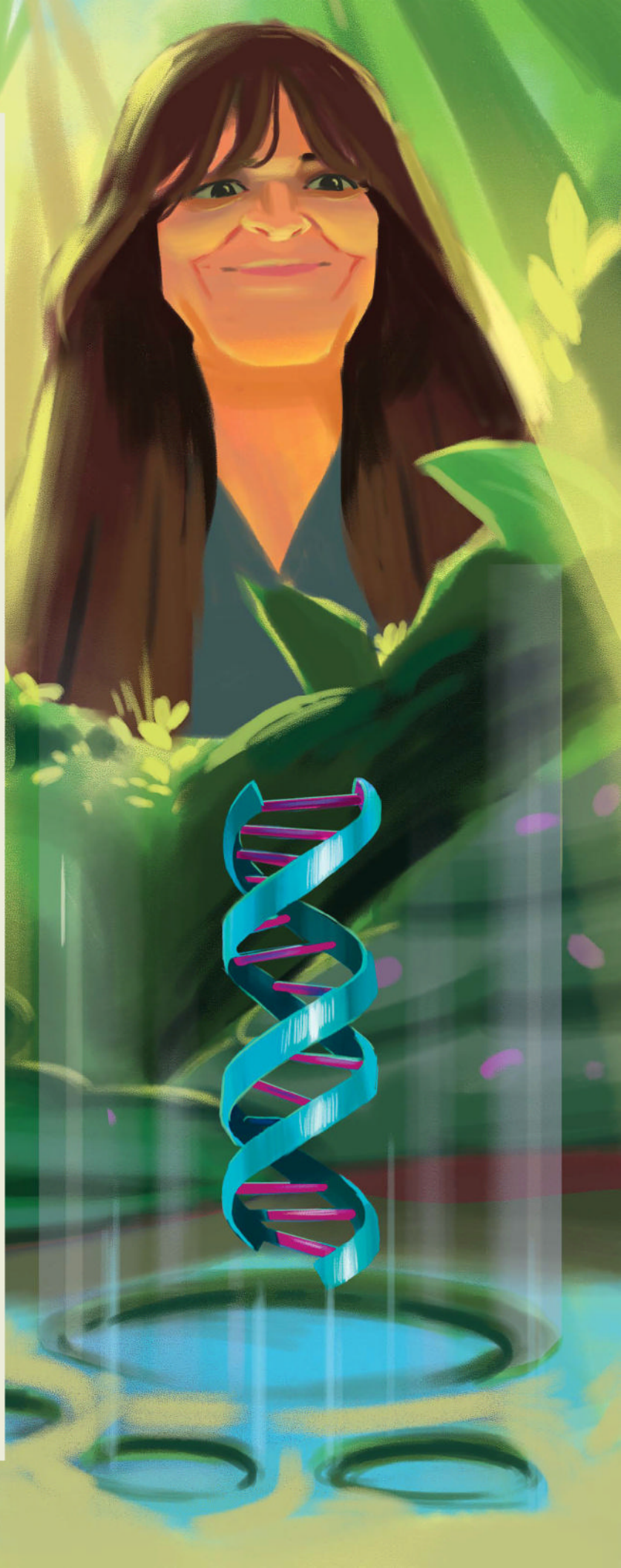
Ghost catfish are not pale as ghosts; they have rainbow radiance instead!

The ghost catfish is see-through. These fish have tiny stripes on their muscles that can break white light into its seven colors, like a rainbow. When physicist Qibin Zhao of Shanghai Jiao Tong University examined the fish in white light, he noticed the colors in the fish. In an experiment that involved using the skin and muscle fibers of the fish separately, scientists found that the muscles produce the rainbow radiance. The muscles contract as the fish swims, and this causes a shifting rainbow radiance along the body of the fish.

Credit: Vassil via Wikimedia Commons

DNA HUNTING IN THE JUNGLE WITH

MRINALINI ERKENSWICK WATSA



Mrinalini is a DNA hunter. She prowls the Amazon jungle and African grasslands, following monkeys, jaguars, elephants and leopards, collecting the DNA they leave behind in footprints, fur, and poop. Mrinalini is not just a geneticist, she's a wildlife biologist working hard to save endangered animals. She's built high-tech laboratories in remote places far from access to electricity. And she teaches genetics in the jungle. All that, and she's also a mom.

If you connect the dots in Mrinalini's life, it's more like a squiggle than a line. "You grow up thinking that to be something, you have to do ABCDE to get there," she says. "And if you get off that path—like you choose to be a mom or try something new—it's considered a terrible waste and you must get back on track. The truth is, there is no one right path. You don't have to choose; you can be everything."

Mrinalini's circuitous path led to big changes in wildlife research. She's created new ways to study endangered animals. "We don't really know how many animals of any one rare species are left," she says. Until recently, our best way of counting wildlife was using hidden cameras. That works if you can tell the animals apart, like leopards and cheetahs with individual spot patterns. But cameras have problems—like when giraffes walk by, the camera only sees their legs! So, Mrinalini is identifying animals by their unique DNA, shed from their bodies wherever they go. And that same DNA tells more—who's related, who's sick, who's having babies. But DNA is analyzed in expensive labs in cities and universities, often outside the countries where animals are most endangered. It can take weeks, piles of paperworks and lots of money to send out DNA samples and get results back. To solve that, Mrinalini's brought the labs to the animals, building portable (sometimes in a tent!) and permanent labs in the wild, and proving that low-cost, cutting-edge genetics can be done anywhere, by anybody. "If you can cook, you can do genetics," she avows. She teaches lab techniques to residents and to students who come to her labs from all over the world.

LIVING WITH WILDLIFE

Mrinalini grew up in southern India. Her love of animals came early when—at age nine—her family moved out of the city into the country where they could afford a house. She and her sister explored, discovering all sorts of creatures, even cobras. Jackals howled outside her window at night. She started an Animal Lovers Club at school, with friends who had sleepovers at her home. "We once tried to hatch lizard eggs, and cooked them accidentally because they were too close to the light." The memory still makes her sad.

FINDING HER OWN PATH

In India every year, millions of 10th grade students compete in national exams which shape their future. The enormous pressure takes a huge toll on teenagers. Although Mrinalini did well, her parents encouraged her to escape the stress. She found an all-expenses-paid scholarship in Singapore, a tiny nation off Malaysia near where she now studies the rare Sumatran tiger. Being far from home at fifteen and being taught in a language she didn't speak was a struggle (although she spoke four other languages fluently, including English). Her grades suffered. Fortunately, she aced a U.S. college admissions test she discovered, called the SAT, and was invited to attend Grinnell College in the United States.

DNA AND JUGAAD

DNA fascinated Mrinalini. She was amazed at these molecules in every living cell that contain instructions—like a biological recipe—to make a particular plant or animal. She devoured everything in college related to molecular biology. Her favorite course offered independent projects. She could ask any question that interested her, but she had to design the experiment herself, do the work, and write up the results in six weeks. She did five of those, and learned how to do research. In graduate school at Washington University, Mrinalini combined her love of DNA and wild animals. Plus, they gave her a stipend, much-needed money to pay off college loans. Her early projects were in the Peru jungle with tamarins, squirrel-sized monkeys. The amount of field work was staggering—following, capturing, and releasing animals—but she didn't let it deter her.

> *There's a Hindi term, **Jugaad**, It's like a 'hack' and means 'creating new things without many resources.' It's how I approach everything.*

In the spirit of jugaad, she invited students to Peru from all over the world to assist her and learn field research in one of the most biodiverse and threatened biomes on earth. This blossomed into Field Projects International, today a thriving research and education program.

“
She has since trained over 300 conservationists, 70% are women. “They help multiply everything I do by 20 or 30,” she says.

GENOMICS IN THE JUNGLE

What led her to bring cutting-edge gene technology to the jungle? "I've learned that being brown in America is not an asset," she says. "So now, when I walk into a room, I represent a group of people for whom it has been an effort to get there. And because I'm in that room, I can actually refocus a conversation, and redirect money towards things the rest of them just don't think about. And I can give other people the same opportunity I had."

In Peru, every other scientist collecting DNA complained about how hard and expensive it was to export DNA samples. But nobody ever questioned why they exported them. It was Mrinalini who thought of bringing the lab and its technology to the animals. With her inexpensive, but high-tech DNA labs in place, Mrinalini has brought genetics education to people in some of the remotest reaches of the planet.

DNA HUNTING

A particular day of DNA hunting in the Peruvian jungle sticks in Mrinalini's mind. She was on a riverboat with her students, as well as her twin six-year-olds, testing a new idea. Could footprints be swabbed for DNA to identify animals? They stopped at one muddy riverbank where lines of animal tracks came out of the dense jungle to the water's edge. Her boys thought it was the best playground ever, and ran around in circles in the mud. Mrinalini and her students protected one clear set of footprints they hoped might be a jaguar, but could have been almost anything. They swabbed them and took the samples back to the field lab, wondering 'Would footprint-swabbing even work?' Students did the entire analysis, learning everything from pipetting to sequencing. The mood was somber. They were full of doubt, knowing it was a long shot. Then, the data came up on the computer and everyone cheered. The DNA was clearly jaguar! After that, the students swabbed over a hundred different footprints, identifying DNA from animals like caiman, capybara, and puma. But what made it most exciting for Mrinalini was the people doing the lab analysis were not geneticists with PhDs. They'd learned to do genetics there, in her lab. And it all started with her boys playing in the mud.

Credit: San Diego Zoo Wildlife Alliance

WHAT GENETIC QUESTIONS WILL YOU ASK?

Mrinalini is excited about kids doing DNA analysis, as genomics becomes more and more accessible. Low-cost DNA sequencers can be found in schools and community bio-hacker maker spaces. Remember, she says, "If you can cook, you can do genomics, because you follow a recipe in both." She urges kids to get their hands on a pipette, do some sequencing, and explore questions that interest them. Make mistakes. Discover what happens if you accidentally double an ingredient. Volunteer in a lab, she suggests. They can't pay you most of the time, but they will be happy to show you how something works.

WHEN MRINALINI'S NOT WORKING...

What are you having for dinner tonight?

I have no idea! I know I said, 'If you can cook, you can do genomics because you follow a recipe.' But it doesn't work the other way around. I tend to throw things together, so I will probably decide just before dinner.

What favorite game do you play with your kids?

The Iron Snake! It's an African version of Chutes and Ladders, but the path you're following is the railway track from Mombasa to Kampala and along the way you get eaten by lions and gored by hippos. And black mambas send you back to the Start.

What's your dream vacation place?

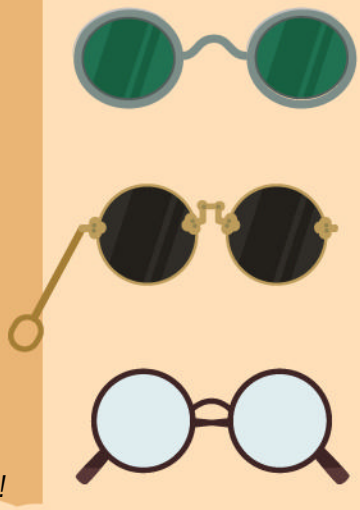
The beach. Any beach.

HOW DO EYE GLASSES WORK?

Glasses are worn by people in every corner of the world. Learn about how these seemingly magical pieces of glass let people see.

Did you know?

About 79% of the American population needs a form of vision aid. This can include prescription eyeglasses, contact lenses, or laser corrective surgery. Of these 198 million people, a majority of about 84% use eyeglasses! This proportion increases as people get older, and most senior citizens use some form of vision aid.



The spectacular invention of eyeglasses, also called glasses or spectacles, helps millions of people every day. But how exactly do they work?

Who invented glasses?

It is unclear exactly when and where glasses originated, but its clear many people all over the world had similar ideas.

The oldest recorded use was by the Ancient Roman Emperor Nero, who would hold an emerald up to his eye when watching his gladiators fight in the Colosseum.

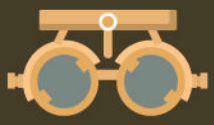
Marco Polo reported seeing people in China holding two pieces of glass fixed to a frame up to their eyes.

Modern eyeglasses, which rest on the ears, are thought to have been invented by Salvino D'Armati in the 13th Century.

His grave even bears the inscription "inventor of spectacles." At this time, glasses were so expensive that they were specially bequeathed in people's wills!

Glasses largely remained the same until the 18th Century. Benjamin Franklin is popularly credited with the invention of bifocals, but there is evidence that artists Joshua Reynolds and Benjamin West jointly discovered them at around the same time. Before bifocals, people who were both near-sighted and far-sighted needed to switch between two pairs of glasses when viewing objects at different distances.

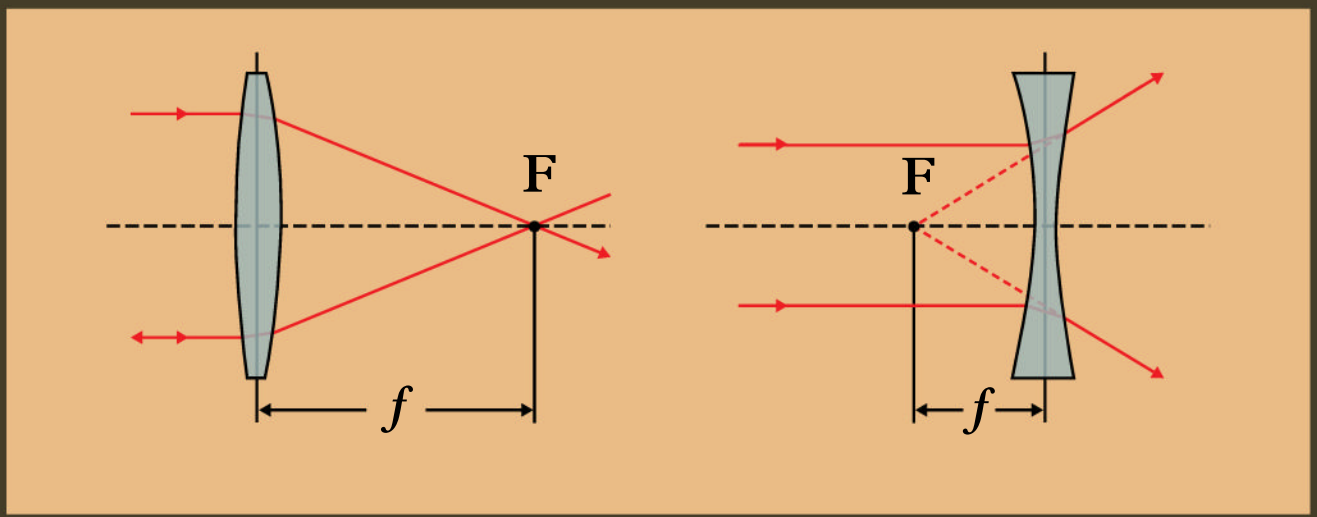
During the early 20th Century, Owen Aves invented the progressive lens. While bifocals were revolutionary, they still could not work on objects at an intermediate distance. The progressive lens solved this issue and is now one of the most popular types of glasses.



What is a lens?

Lenses work on the principle of refraction. When light touches or falls on any surface, it can get reflected, refracted, or absorbed. When light gets reflected, it goes back the way it came, as with a mirror. When light is absorbed, none passes through. When refraction occurs, the path of the light changes.

Refraction occurs due to a change in the speed of light. The more solid the medium, the slower the light travels. Refraction can be viewed using a simple experiment. Place a pencil in a glass half-full of water; the pencil will appear as if bent at the border of the water and air because light moves more slowly through water than air.



A lens is just a thin piece of glass. Light slows down when it moves from air to solid glass, and the path changes. Light can either get reflected outward (diverge) or inward (converge), leading to the classification of two main kinds of lenses: diverging and converging. The change in the path of light depends on the shape of the glass.

Lenses are named after the Latin word for lentil: lens. In fact, a convex lens looks just like a lentil! It has one flat end, and one outward curving end. Convex lenses converge light. Concave lenses curve inward, just like caves. These lenses make light diverge. In other words, convex lenses are converging lenses and concave lenses are diverging lenses.

When light rays meet either in front of or behind a lens, an image forms. This image is a representation of whatever object sits in front of the lens. Depending on where the object is, the image might be right side up, upside down, zoomed in, or even shrunken down.

Fun Fact

The human eye has an incredible number of parts, and is very intricate. For the eye to function right, every single piece needs to work correctly!

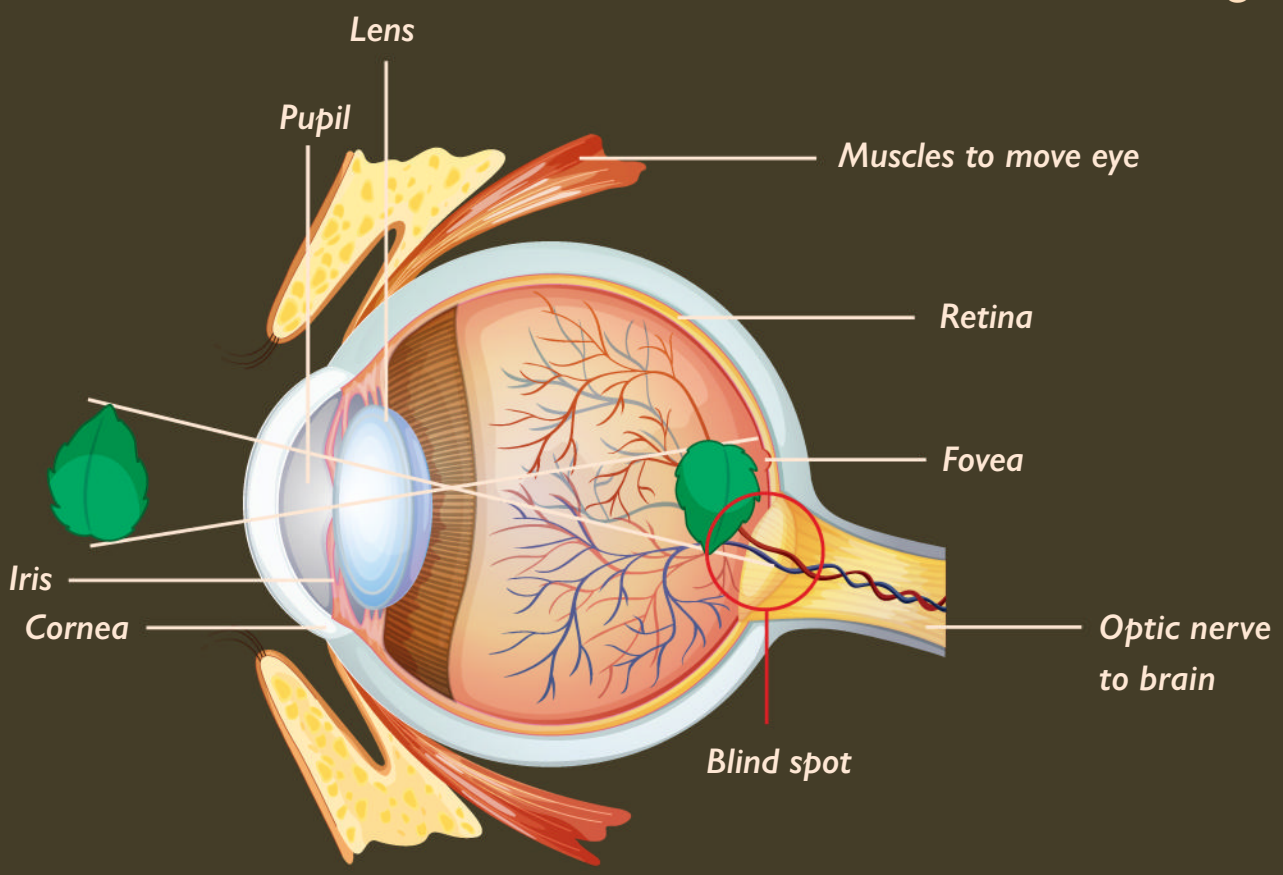
How does the human eye work?

When light hits the eye, the first part it interacts with is the pupil. The pupil looks like a black dot but is actually an opening, and it changes size depending on how much light is available. When it is very dark, the pupil becomes larger to allow as much light as possible into the eye.

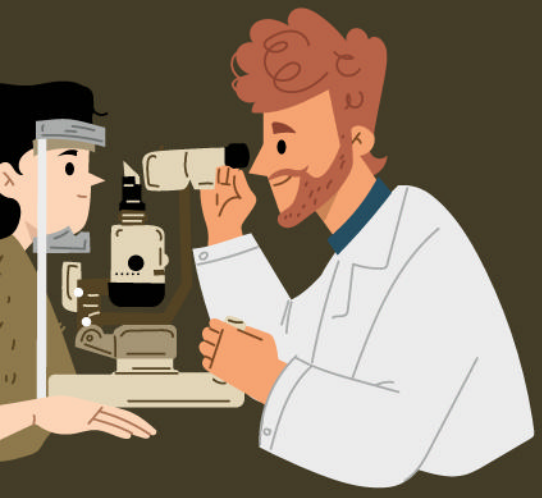
Once light passes through the pupil, it hits the lens. The human lens is just like a glass lens. It causes light to slow down. The lens is attached to the rest of the eye with muscles above and below it. When you focus on an object, these muscles move to either squash or pull on the lens. This causes the light rays to meet at different points.

In a perfectly functioning human eye, the light rays meet on the retina, forming an exact image of the object seen. The retina is connected to many nerve cells, which translate the image to the brain, allowing us to understand what we see! This very elaborate process takes only milliseconds.

Cross section of Human Eye

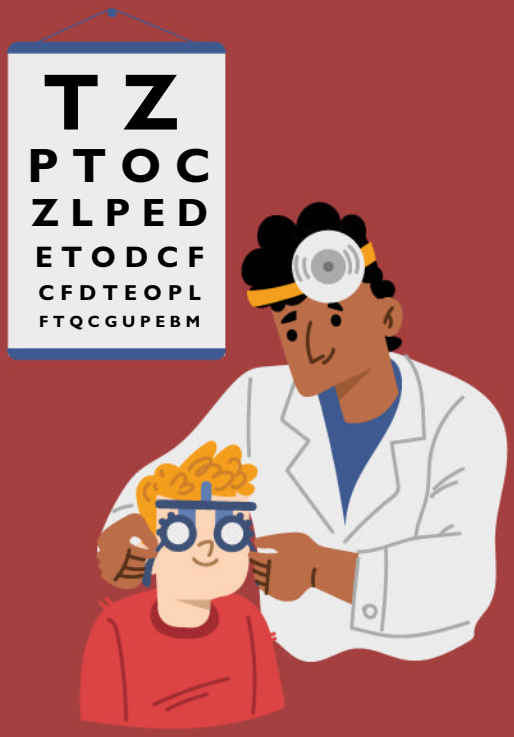


Why do people need glasses?



With how many dedicated parts there are in an eye, is it any surprise that eyes do not work quite right in 79% of people?

Glasses are meant to correct for problems in the lens. When the lens is not formed correctly, it can cause light rays to converge either too close to or too far from the retina. The brain cannot translate the image properly, causing it to be blurry and out-of-focus. The farther the image forms from the lens, the higher the "power" of the prescription needed.



Diverging lenses cause the rays to be moved farther apart when they enter the eye. When the image forms too far in front of the lens, a diverging lens causes it to form farther behind, exactly on the retina. A diverging lens corrects for nearsightedness. A converging lens is used when the image is formed too far behind the lens, for people who are farsighted.

A thin piece of glass can easily fix an error in one of the most carefully arranged organs. These lenses have evolved from a plain cut emerald, too expensive for anyone but an emperor, to something anyone can pick up at a department store.

Glossary

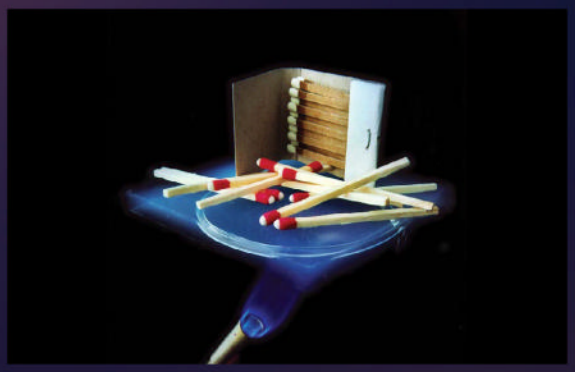
Absorb:	*The process by which light is stopped by an object*
Bifocals:	*A type of glasses that work for both nearsighted and farsighted people*
Converging lens:	*A type of lens that causes light rays to meet*
Convex lens:	*A type of lens where the glass bends outward*
Diverging lens:	*A type of lens that causes light rays to move apart*
Laser corrective surgery:	*A surgery that uses a laser to reshape the cornea (the clear covering over the front) of the eye and so correct nearsightedness, farsightedness, or astigmatism*
Lens:	*A thin strip of glass which causes light to refract*
Pupil:	*An aperture in the eye through which light can pass*
Reflected:	*The movement of light back to the direction from which it came*
Refracted:	*The change of the path of light due to a change in its speed*
Retina:	*A thin layer on the inside of the eye that receives light and translates it into images that are sent to the brain to be understood*

Cool Chemicals

Discovered by Humans

The human mind has always tinkered around with materials. Even in olden times, we had people trying to convert cheap metal into gold using a not-so-sciencey method called alchemy. Halfway into the 20th century, we were experimenting with nuclear fusion, but this time it didn't involve gold, but uranium. What magic materials did we bring into existence, and what cool chemicals did we find in nature? Let's see where the list takes us.

Aerogels



Aerogels can resist temperatures over a thousand degrees Celsius!

Aerogels are like feathers in a cube. Aerogels are one of the lightest solids that we have ever made. If you were to roast regular jelly in an oven, all of its moisture would dry out, leaving a heap of powder. In the case of aerogels, the gel holds its shape to form a solid, while the liquid portion of the gel is dried out and replaced with air. These wonderous creations might be porous and not very dense, but they are amazingly resistant to temperatures of up to 1300°C (2372° F). They can also deal equally well against cold, and so are used as a blanket against outside temperatures in Mars rovers. NASA gave this type of substance the nickname "Blue Smoke."

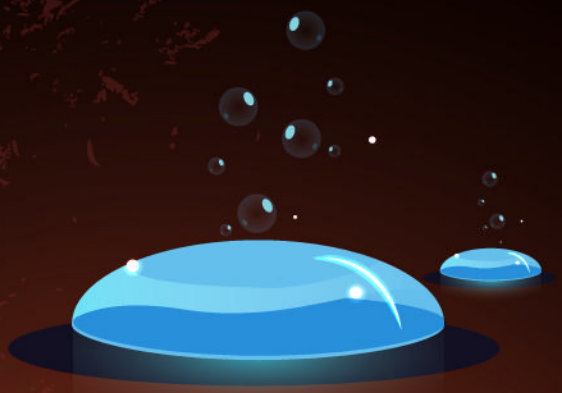
Gallium

A drop of gallium doesn't seem to be a metal, but it is.

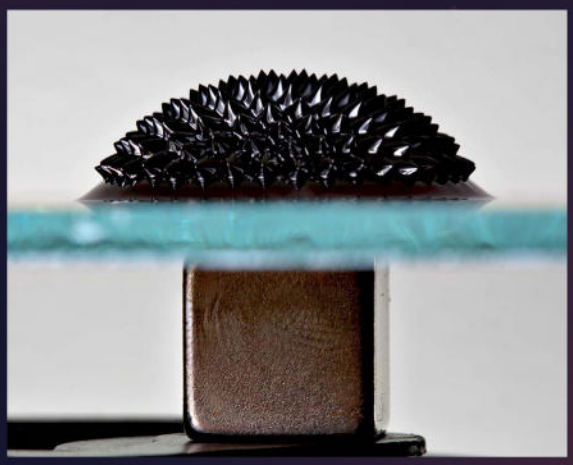
If you were to see a chunk of this substance, you would doubt your sight. Silvery, flowing, and yet, quite evidently a metal, gallium is weird. While many metals need almost thousands of degrees to melt, you will find gallium melting in your palm. Gallium is rare and can degrade other metals. Currently, gallium finds usage in smartphones and aerospace equipment, but it would make a great plaything, too. You can buy gallium packed in tubes from Amazon!

Credit: NASA/JPL-Caltech via Wikimedia Commons

Credit: Pixelmaniac pictures via Wikimedia Commons



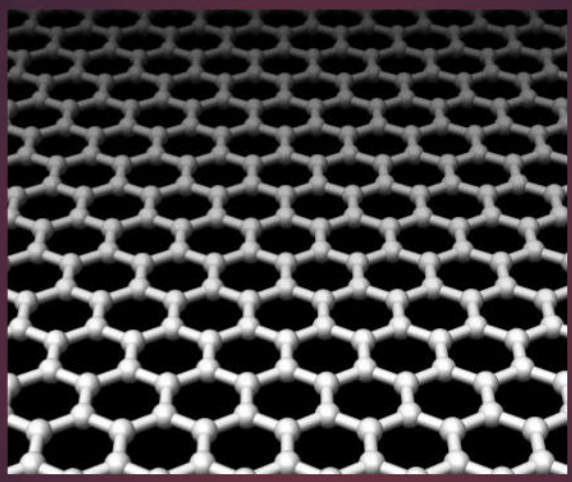
Ferrofluid



A magnet moves ferrofluid across a table. What would you name your pet liquid?

You can pretty much have a liquid pet, considering the "lively" nature of ferrofluid. You can control ferrofluid using just a magnet. The best part: you can make it at home. All you need are a few spoonfuls of vegetable oil and some iron filings. Mix them until you reach a sludgy consistency. Grab a magnet, and bring it close to the ferrofluid. Watch as the magic unfolds, as the fluid starts to wiggle and move around like a living being.

Graphene



Graphene is thin but stronger than steel.

Graphene takes the cake in many fields. Do not let its size or dimensions fool you. Graphene is a sheet of a single layer of carbon atoms, arranged in a honeycomb shape. Multiple layers of graphene make graphite, the substance that is used to make pencil leads. Graphene is the best conductor of electricity and heat, and is stronger than steel. Graphene can also be combined with aerogel to form aerographene, and it is the lightest material made by humans. Graphene will eventually be used as a conducting material because of its sturdiness, and ease of electric flow.

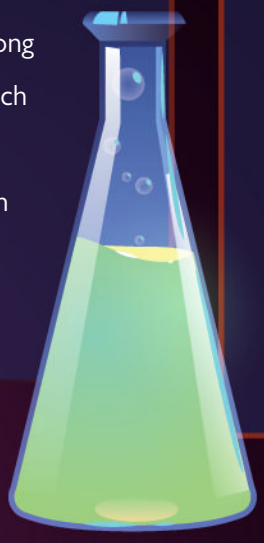
Credit: Gregory F. Maxwell via Wikimedia Commons

Credit: Carbophiliac via Wikimedia Commons

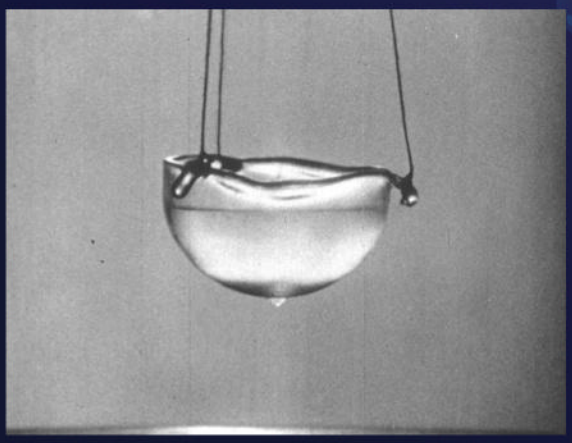
Superhydrophobic surface

A water droplet bounces like a ping-pong ball on a superhydrophobic surface.

"Phobic" comes from the word "phobia," meaning "fear." Hydrophobia is simply the fear of water; in a metaphorical sense, when talking about liquids that don't mix with water. Common examples would be oils and grease. If you pour oil in water, you will find that oil forms globules inside water rather than getting mixed in. When a water droplet is dropped on such a surface, the hydrophobic properties can make the droplet bounce off like a ping-pong ball, while the surface remains dry. This tech finds future applications in anti-freeze technology. Or if you had a shirt with such coating, the shirt would never get wet. A "no splash" dress sounds pretty cool!



Superfluid helium



Quite a "chill" liquid, superfluid helium breaks way too many rules of physics.

As a kid, I used to watch drops of water flow down along the wall and recorded the ones that came down the fastest. My amusement might have been greater had I known about superfluid helium back in those days. Superfluid helium is liquid helium at −272.5°C (–458.5°F). This fluid has zero viscosity and can act against gravity, climbing walls. Viscosity is the force of friction offered by the liquid. Imagine water in a pond having layers, like a stack of books. If you slide one book on top of the stack, the movement will be opposed by the book below it, and so on. The same happens in a body of water. However, this goofy fluid is beyond the reach of such commonplace forces. The Harry Houdini of all fluids, superfluid helium can escape through microscopic cracks and gaps, something that neither any other liquid nor any other gas can do.

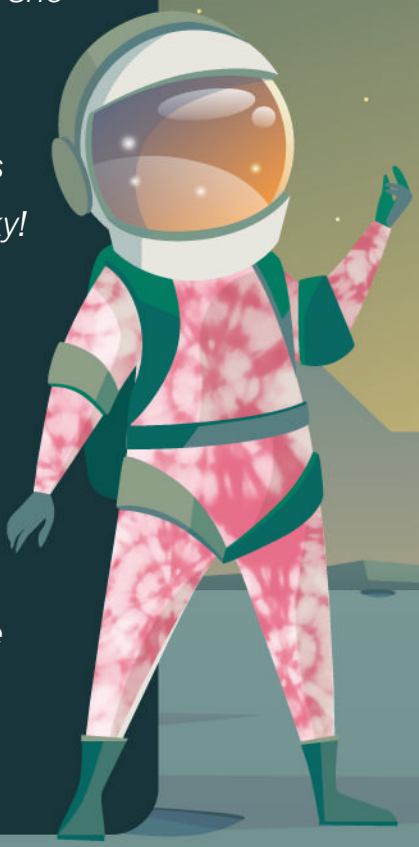
Credit: Friedrich1997 via Wikimedia Commons

Credit: AlfredLeitner via Wikimedia Commons

The Future of Space Exploration

It's your school spring break. The final bell rings, and you and your best friend run outside. "What are you doing for break?" you ask. "We're going to Mars for the week!" she replies. Her parents suddenly land in their personal spaceship to pick her up from school. She climbs in, puts on her custom tie-dye pattern space suit, straps into her seat, and they lift off into the bright sky. Lucky! At least you'll get to go to Mars in the summer.

Will space tourism like this ever be possible? Will everyone have their own personal spaceships? Will any planets besides Earth be habitable, or potential homes, for humans? Are any other planets already home to different types of organisms? What does the future of space exploration look like?



Why do we explore outer space?

We know plenty about our own solar system and the systems beyond it. We have named planets and explored how they are different from planet Earth. We know how they revolve around the Sun, and we have become skilled at predicting patterns in the night sky. We even know when comets and asteroids will pass by. But there is so much more to explore. We study space because we are curious. Curiosity landed us on the Moon. Curiosity is even the name of a rover that is currently exploring Mars.

But there are other great reasons to explore space, too. Learning about space helps us to learn more about our own planet. Our planet is one of a few known planets in the universe that can potentially support living creatures and organisms. When we learn more about those planets, we can make better decisions about how to support our own planet. Humans are facing issues like climate change, and learning about space can help us to be more informed about how to treat our planet. Some scientists even say that we need a "Planet B," or another place where humans can live in case of an emergency on Earth.

An astronaut on the International Space Station

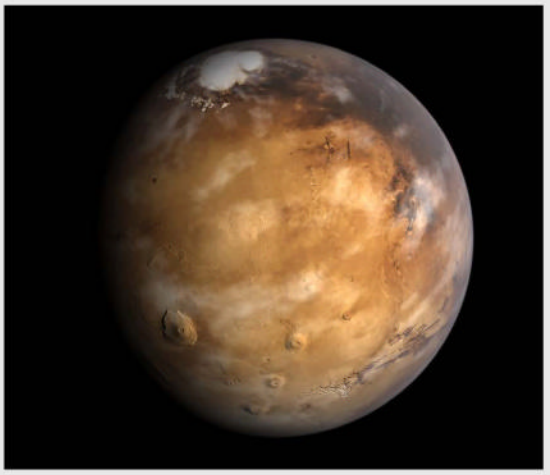
Credit: NASA's Marshall Space Flight Center

Are any other planets habitable?

A habitable planet is one that can support living organisms. NASA, the National Aeronautics and Space Administration, has tools to discover whether certain planets could support life. In our solar system, we know that Earth supports living creatures. There is also a possibility that living organisms could exist below the surface of Mars. Even though we have found other planets that could support life, only Earth is known to have living organisms. We also know that it took over 4 billion years for Earth to have intelligent living creatures. So it is possible that some of these planets may have intelligent life in the future, even if they do not right now. It can be tricky to learn about these planets because they are so far away. But there is plenty to explore nearby in space, as well.

Fun Fact

In other solar systems, there are planets similar to Earth that are in the Goldilocks Zone, where planets are not too hot or too cold, but may have just the right conditions to support life.



Mars

What are the next steps in exploring the universe?

We have already been to the Moon and landed exploration rovers on Mars. But in 2024, humans plan to return to the Moon and build a space station and even a base camp for more exploration. Some say that by 2050, we could have a permanent site on the Moon. We will also continue to explore Mars and eventually build a research center there.

Moon landing

But what about the space beyond our solar system? Is it possible to travel even farther? It takes three days to get to the Moon, but it takes seven months to get to Mars. Traveling to the edge of our solar system would take hundreds or thousands of years with current technology. We can explore deep space with powerful telescopes like the James Webb telescope. This telescope orbits around the Sun and can see over 13 billion light years away. Telescopes like this, and other impressive technologies, help us to locate and learn about other solar systems.

Will humans ever become space tourists?

If Mars is a seven-month trip away, it's not likely that your friend from school will go there for spring break on vacation with her family. However, we are taking steps, or taking flight, into the future of space tourism. In September of 2021, a crew of four people who were not astronauts took off into orbit. The team included a physician assistant, a geoscientist, an Air Force veteran and data engineer, and an aviator. The physician assistant, Hayley Arceneaux, was the first person with a prosthetic body part to go into space. This team spent three days in orbit and landed safely in the ocean before returning home. Missions like this will happen more in the future. Scientists are even working on making rockets reusable so that we can bring down the expensive cost of space travel. It may be a long time before anyone has their own personal spaceship, but we are flying in the right direction.

Credit: Kevin M. Gill *Credit: Futurilla*

What challenges come with space exploration?

With more space missions and stations around the solar system, humans produce something we are very familiar with on Earth: garbage. But this garbage is a bit more dangerous than our trash on Earth. Space debris is any human-made object that no longer has a function and is floating in the solar system. There are over 27,000 pieces of space debris being tracked by NASA, because they may crash into satellites, space stations, or even Earth, causing damage. Every time space debris collides with something, it creates more space debris, and it is not easy to clean up. In the future, we will need to find ways to overcome this issue so that we can safely navigate the solar system.

The International Space Station

Credit: NASA Goddard Space Flight Center

Glossary

Habitable	describes a planet that could support life
Rover	a robot that explores the surface of a planet or moon
Nasa	the National Aeronautics and Space Administration, which studies outer space
Goldilocks Zone	the area in solar systems that is “just right” for planets to support living creatures
Space Debris	garbage floating in the solar system

1. Which atmospheric gas is toxic to humans, but, in the stratosphere, serves as a shield against the harmful UV rays of the sun?

A. Oxygen
B. Carbon monoxide
C. Ethylene
D. Ozone

2. What are medicines used to reduce fever called?

A. Antibiotic
B. Antipyretic
C. Analgesic
D. Sedative

3. A mixture of fog and smoke that reduces vision and can cause suffocation is called?

A. Smog
B. Smof
C. Soot
D. Mist

4. Some organisms can break sugar down to form ethanol or lactic acid, and carbon dioxide along with it. This process has been utilized in breweries for ages. What is the process called?

A. Glycolysis
B. Digestion
C. Fermentation
D. Catabolism

5. This gas is the most abundant of all in the atmosphere. It is used to package food that comes in cans and packets (like chips) because it does not react with the food item and does not let food-spoiling organisms grow. What gas is this?

A. Oxygen
B. Hydrogen
C. Chlorine
D. Nitrogen

6. What is the common name of sodium chloride?

A. Table salt
B. Potash
C. Detergent
D. Washing soda

7. The thermometer makes use of a liquid metal for scaling temperatures. What metal is it?

A. Zinc
B. Mercury
C. Scandium
D. Lead

8. Blood is involved in carrying oxygen to various body parts. Oxygen binds to a certain iron-containing pigment in blood cells, which allows the blood to transport oxygen. Name the pigment.

A. Phycobilin
B. Hemocyanin
C. Hemoglobin
D. Plastoquinone

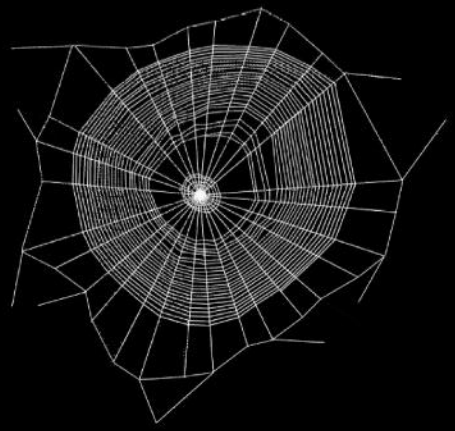
9. When rain drops fall from the sky, what shape are they?

A. Teardrop-shaped
B. Capsule-shaped
C. Spherical
D. Cuboidal

10. Which substance is used in accessories that need to absorb UV light for functioning?

A. Glass
B. Opal
C. Quartz
D. Gypsum

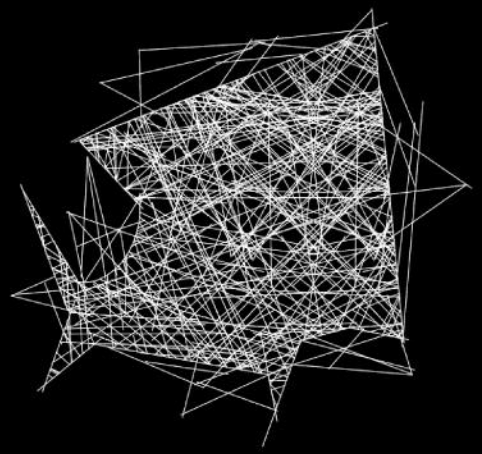
Types of Spider webs



Orb web

Circular webs commonly seen in gardens and forests. They are rebuilt every day.

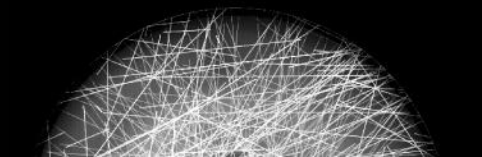
Spider Family:
Orb weavers / *Araneidae*



Tangle/Cob web

No defined shape or pattern. Commonly found in unused spaces.

Spider Family:
Tangle-web spiders/ *Theridiidae*



Funnel web

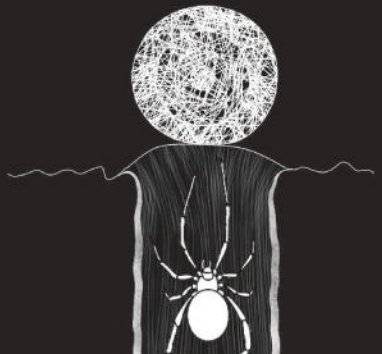
Most Unique Spiders and their Webs

Water Spider

The only aquatic spider species. It stores a large air bubble in its web to live and breathe underwater

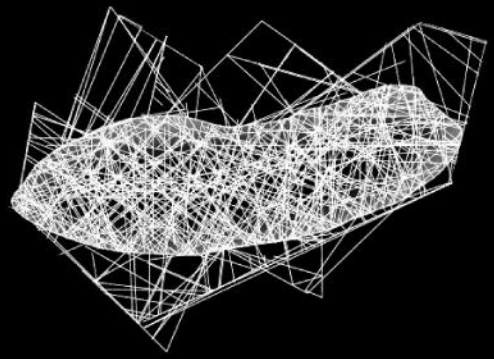
Trapdoor Spider

Weaves underground silk-lined burrows with a trapdoor and attacks prey from below



Most common type of web. Found low on ground in densely wooded areas.

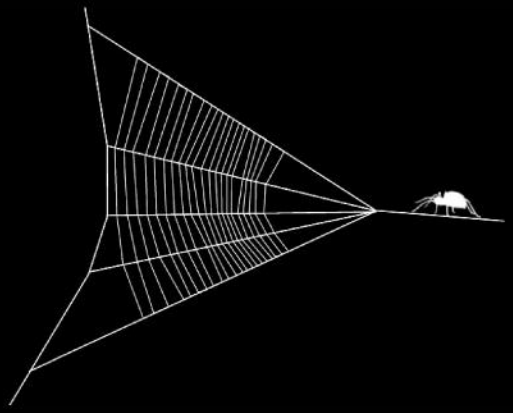
Spider Family:
Funnel weavers/ Grass spiders / *Agelenidae*



Sheet web

Large sheet-like webs seen covering grassy areas or hanging between trees.

Spider Family:
Sheetweb/ Money spiders/ *Linyphiidae*



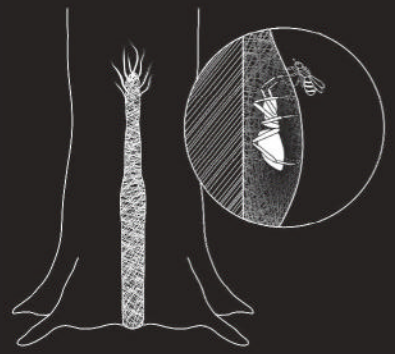
Triangle web

The spider waits for its prey on a tightly stretched triangle-shaped web, and then rapidly propels itself towards the captured prey.

Spider Family:
Triangle weaver / *Hyptiotes cavatus*

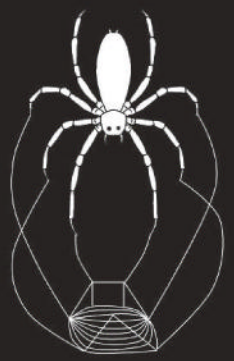
Purse Web Spider

Weaves camouflaged tubelike webs vertically up the sides of trees and hides inside the tubes waiting to catch prey



Net-casting Spider

Weaves small net-like webs held with their legs and drops them on unsuspecting prey like a net



TURNING BACK TIME

HOW SCIENTISTS ARE BRINGING BACK THE WOOLLY MAMMOTH

Scientists are close to breakthroughs in cloning ancient animals. Can we bring back what was lost?

Credit: Aubad, via Wikimedia Commons

When Did The Woolly Mammoth Go Extinct?

When you think of fossils, the first thing that comes to your mind is probably a T-Rex or a woolly mammoth. These iconic giants are one of the best glimpses we have of the Pleistocene, a period from about 2.5 million to 11,700 years ago.

The Earth's climate has always fluctuated. We had massive, dense forests of ferns 300 million years ago. Edge to edge, continents were covered in rainforests so thick and towering that their remnants form the coal and fossil fuels we use now, millions of years later. The Earth's atmosphere was hot and rich with oxygen. During other times, like about 66 million years ago, the Earth became freezing cold and the atmosphere was thick with noxious gasses like methane.

Our Most Recent Ice Age

took place during the Pleistocene, only about 20,000 years ago. At that time

25%

of the Earth's land was covered in glaciers, compared to 8% today.

The Pleistocene Period

The Pleistocene was a time of animal giants. Saber-tooth tigers prowled modern-day Siberia, giant sloths swung through the forests of South America, and the mammoth roamed the steppes of Eurasia.

No matter the time period, large animals have always been more prone to extinction than small animals.

Woolly Mammoth
Mammuthus primigenius
15 ft

Giant Ground Sloth
Megatherium americanum
Stood 12 ft on its hind legs

Saber Tooth Tiger
Smilodon populator
4 ft

Average Person
5 ft to 6 ft

Credit: Charles R. Knight via Wikimedia Commons

Why did large animals go extinct?

The first reason is **food**. In order to get big and stay big, you need to eat big! In times of climate change, resources become scarce. Large animals are more affected by this scarcity than small ones are.

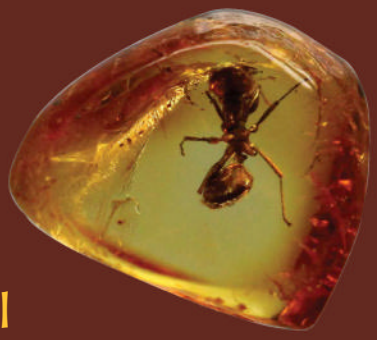
Secondly, large animals tend to **reproduce slowly**, and depend on parental care for longer. This means they are much more likely to decline when they lose a few members.

Another factor seems to have contributed to late Pleistocene extinctions—us. Many large mammal extinctions map onto the same times that humans reached those continents. Scientists are still debating how much of a role our hunting played in these extinctions, and how much was due to climate change. It also varies from species to species. Today, mammal giants exist only in Africa, Asia, and the oceans.

Between humans, climate change, and massive bodies, mammoths stood very little chance. The last population lasted until 4,000 years ago, but most went extinct much earlier.

What is a fossil?

There are many different kinds of fossils, but what links them together is their ability to represent the past.



Amber fossil

Amber fossils are bits of insects or bones which have been trapped in tree resin, which slowly hardens to form the semi-precious amber. Trapped within the resin, nothing happens to these bits.

Impression fossils

Impression fossils are imprints of organisms which affect the rock around it. Many plants, and even microbes, have been identified this way! Our oldest fossils are microbe impression fossils, made 3.8 billion years ago.

Credit: Manukyan Andranik via Wikimedia Commons

Credit: National Archives and Records Administration via Wikimedia Commons

What does a fossil tell us?

The fossil record is a crucial puzzle piece in documenting pre-history.

Animals that are fossilized help us understand which organisms evolved from which, and how modern organisms are related.

By dating the rock or material the fossil is in, we can understand when this organism existed.

Fossils even tell us how different animals made their way across continents.

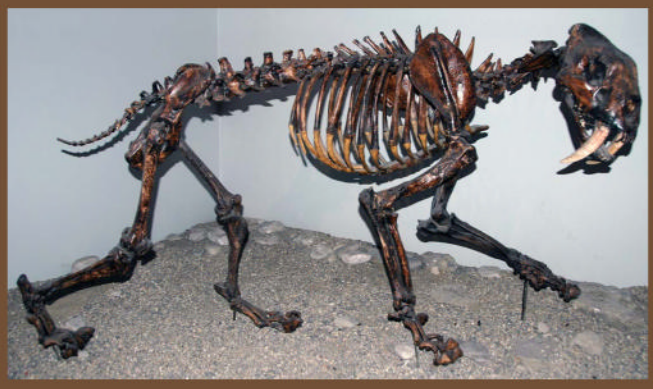
Imagine a trail of fossils across Russia, into Alaska. This is how we discovered the way many animals reached North America!

The woolly mammoth fossil record is particularly spectacular. Woolly mammoths existed relatively recently, in terms of the history of the entire Earth. The first woolly mammoth fossil was discovered as early as 1728. Even then, the similarity to African and Asian elephants was noted.

favourable conditions for fossil

There are some conditions which favor the formation of fossils. Volcanic eruptions are excellent, because they trap animals in rock before the bodies have a chance to decay. Similarly, the icy tundra of Eurasia makes an excellent environment for mammoth fossils. The cold preserves bones, and even tissues! Until the past decade, extracting DNA from fossils was impossible, because fossils were just so old. Now, we have not only extracted mammoth DNA, but are even ready to clone them.

A fossil of a mammoth calf "Dima"



A fossil of the Saber-rooth tiger

Credit: Ghedoghedo via Wikimedia Commons

Credit: James St. John via Wikimedia Commons

What is the Pleistocene Park?

If we can clone mammoths, what's stopping us from creating Jurassic Park? This is exactly what scientists are attempting to do in Sakha Republic, Russia. Because the Pleistocene extinction was so recent, and human hunting contributed to it, some scientists feel a responsibility to return the mammoth to life.

The initiative centers not only on bringing the mammoth back, but on restoring their entire ecosystem. There are even potential climate change benefits, as the cold grasslands the mammoths subsisted on took in massive amounts of carbon.

The park is currently small, around 20 square kilometers. The reindeer, Yakutian horse, moose, bison, musk ox, sheep, camel, goat, and Kalmykian cow have already been reintroduced.

Restoring Pleistocene organisms is still somewhat feasible within current scientific technology, as the quality of fossils is excellent. Soft tissues, such as fur and organs, have been well-preserved—not just as bones or impressions.

Right now, bringing back the T-Rex is unlikely. However, as science continues to evolve, this might not be so impossible. What would the world look like if everything that once existed, continued to? If we brought the mammoth back, would you go to Russia to visit it?

Artist's depiction of hunting of a wolly mammoth

Credit: Unknown via Wikimedia Commons

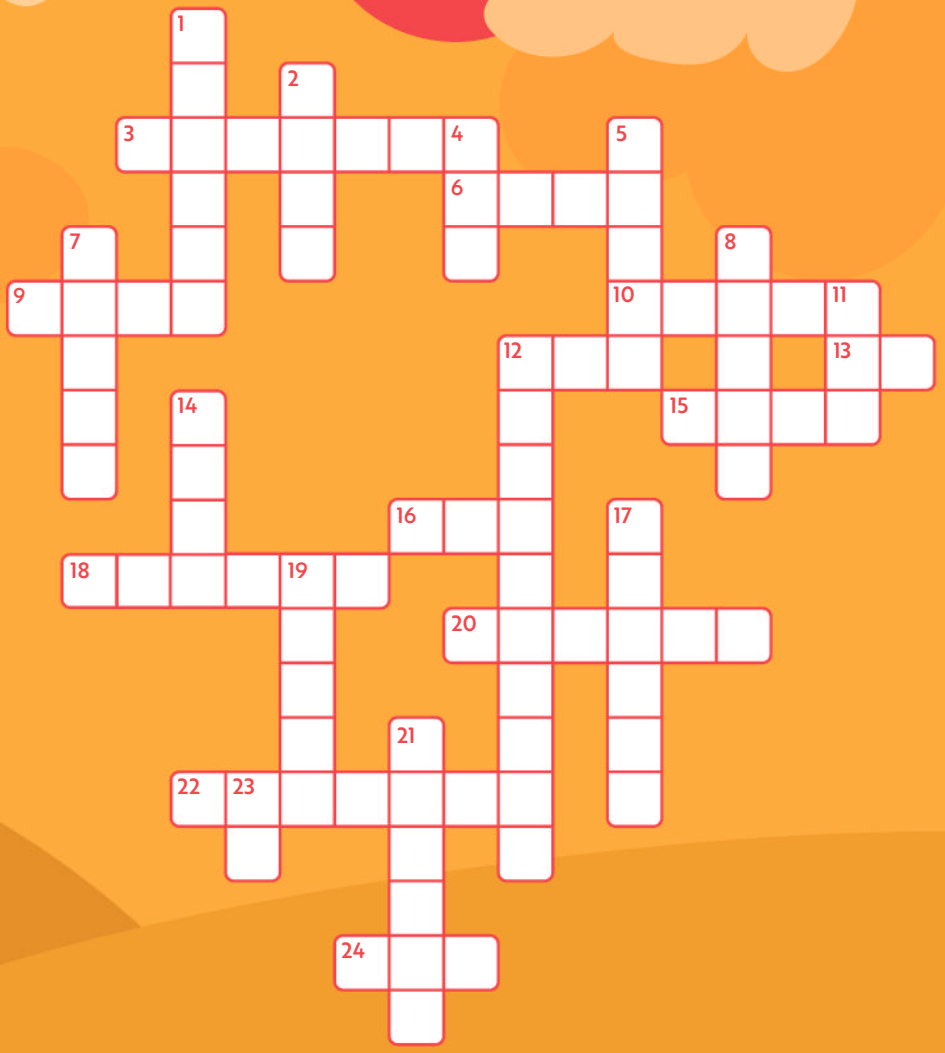
Glossary:

DNA :The genetic blueprint of an organism

Fossil :The remains or impression of a prehistoric organism

Pleistocene :A time period between 2.58 million years ago to 11,700 years ago, during which the last ice age (last glacial maxima) occurred

CROSSWORD



Across

3 French naturalist Jean Baptiste Lamarck believed that these herbivores had short necks that become longer to reach the leaves on taller trees

6 What color is the blood of an octopus

9 How many hundred million years ago was the period of time called the Devonian period

10 This tiny organism has the greatest number of teeth in the animal kingdom, over ten thousand

12 The only mammal that can fly

13 The title of a movie; the same as a term describing hypothetical life forms from outside Earth

15 The number of neutrons present in hydrogen

16 In a mixture made of oil and water, which floats

18 Brightness in a certain direction is measured in candela. From what common light source do we get the unit name "candela"

20 These monkeys live in the Amazon rainforest, and are the loudest among all monkeys

22 How many liquid ounces form a pint

24 Which blood cells carry oxygen?

Down

1 This region around the Sun, extending outward from the orbit of Neptune, is where a lot of comets arise

2 Which has a more painful sting—wasp or bee?

4 The phase of tide in which the water level falls

5 The fungi that digests sugar in dough and makes it rise

7 The name of the first cloned mammal, which was a sheep

8 The common name of dihydrogen monoxide

11 The species name of the lion

12 Some spiders use their webs as a parachute to glide using the wind; this behavior is called

14 This part of a rhino is made up of the same materials as the nails and hair of humans

17 The liquid form of this gas can move upwards against gravity

19 The substance from which rubber is made

21 This mammal builds dams across streams and ponds using rocks and branches, to serve as its home

23 When something is injected inside what is it called (abbreviation)

Going With the Floe

Professor Polar Bear and Professor Penguin were teaching a class together. The topic? Sea ice! Both were experts—Professor Polar Bear lived in the Arctic and Professor Penguin lived in the Antarctic—so they should have agreed on everything, right? Wrong! Halfway through the class, they faced off—nose to beak—their mood chilly. What could be so different about sea ice in the Arctic versus the Antarctic? Well, apparently lots.

What did they agree on?

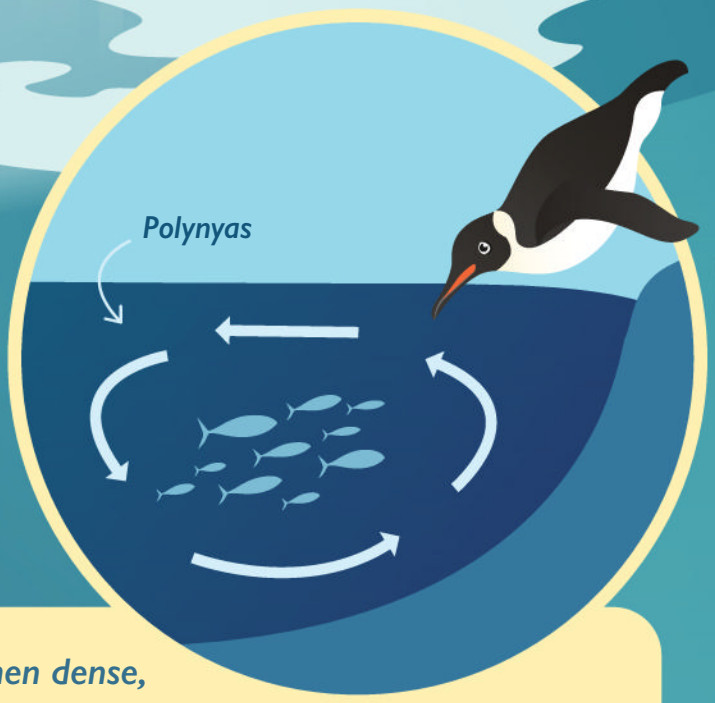
During the cold winter months—remember, winter in the Antarctic is March to October—sea ice freezes over a large area of the polar oceans, then melts in the summer. And because the ocean is salty, it freezes at a lower temperature than fresh water, at 28.8°F instead of 32°F. About 10 million square miles of the ocean is covered by sea ice during some part of the year (an area 2½ times the size of Canada).

As sea ice crystallizes, salt brine gets squeezed out, lowering the freezing point of the nearby ocean, making sea ice slushier than freshwater ice. As it continues to cool, the ice eventually solidifies into large ice floes or firmer ice sheets. Sea ice is almost always in motion, from currents and wind, except where it's frozen to the shore. Ice floes can crash into each other, forming sharp ice ridges.

"Sea ice is almost never flat," groaned Professor Polar Bear. "Climbing over those six-foot ridges—sometimes even higher—is exhausting!"

"It's easier to just jump in the water and swim underneath," agreed Professor Penguin. "Although underwater keels are just like ridges, but pointing downward."

When sea ice gets tugged apart, it opens up channels, or leads. "Leads are where I wait for delicious seals to come up for air. Yum!" said Professor Polar Bear, licking her chops.



A gap in sea ice also forms when dense, salty water sinks and pushes deep water up to the surface. The continually upwelling water prevents freezing. Called polynyas, these open waters are also teeming with life. "Polynyas are where I jump in to go fish-hunting!" beamed Professor Penguin, chomping her beak.

But, unfortunately, that's when they stopped agreeing.

"Sea ice is really thick and old." stated Professor Polar Bear. "And when it melts, I can even drink it!"

"You silly pile of fur!" sputtered Professor Penguin. "Most sea ice is thin. Plus, it's covered in snow!"

How could sea ice be so different?

Sea ice in the Arctic is different than in the Antarctic because the Arctic is an ocean almost completely surrounded by land, whereas the Antarctic is land surrounded by ocean.

The land around the Arctic Ocean is like a fence, keeping the ice from leaving the polar zone, so more of it stays frozen year after year. Trapped, floes are more likely to crash into each other, and pile up into ridges, making the ice thicker (6–30 feet thick). Before recent global warming, over half of Arctic sea ice stayed frozen more than nine years. As sea ice ages, it loses salt, so older ice can be melted for drinking. Ice covers the North Pole, not land.

The Antarctic continent covers the South Pole. Sea ice forms around Antarctica and drifts freely, with nothing to keep it from floating north into warmer waters where it melts. So Antarctic sea ice is thinner (3–6 feet thick) and most of it reforms every year. Antarctic winter storms drop more snow than in the Arctic because they pick up moisture as they sweep across the Antarctic Ocean.

How do we know about sea ice?

Before fur and feathers started flying, the two professors agreed to disagree and shook paw to flipper. "One thing's for sure. In both the Arctic and Antarctic, sea ice is super cool to study." How? Satellites and aircraft can map the ice's extent and measure sea ice thickness from the air. Submarines and undersea drones scan the ice's underside. In 2019, the research boat Polarstern was intentionally frozen into Arctic drifting sea ice for an entire year, with scientists from over twenty countries. Inuit people have lived with Arctic sea ice for thousands of years. Their expertise is invaluable in sea ice science. Sea ice is complex: growing and melting, crashing together and breaking apart, always moving. To understand it, you have to go with the floe.

RITA LEVI-MONTALCINI

Hero of Her Own Story

Narrow escapes, false identities, and tragic romance. They sound like parts of a movie plot. But they were very real for Rita Levi-Montalcini. She was born to a Jewish family in Turin, Italy in 1909. Her strong-willed father directed her childhood. He chose her schools and activities. Besides her beloved twin sister, he even picked her friends. He sent Rita to a high school which, she said, gave girls "all the instruction needed to become perfect wives and mothers." And nothing more. Rita dutifully went. But when she graduated, unprepared for college or a job, she was done following someone else's script. She was ready to write her own story.

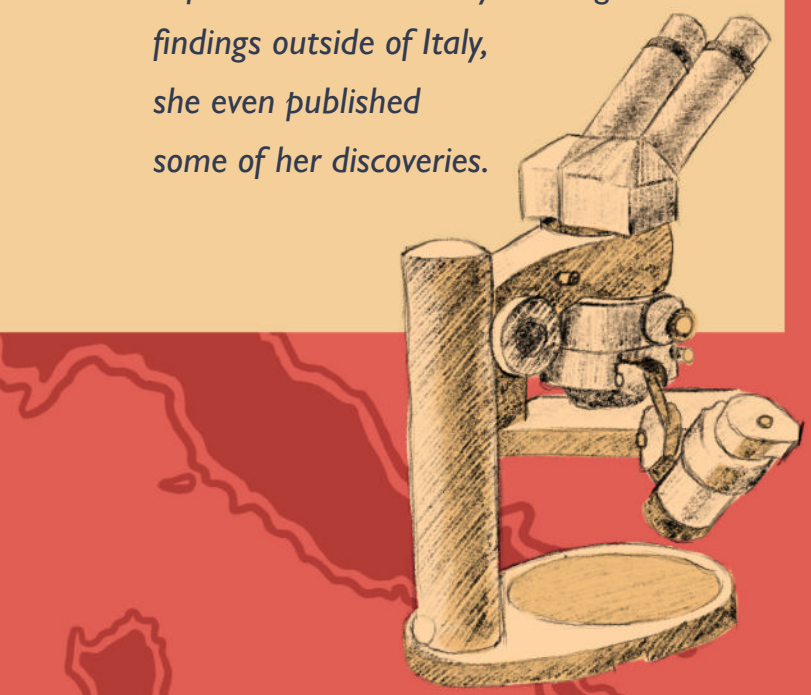
Rita told her father she wanted to go to medical school. With some urging from her mother, he agreed. But only if Rita could pass the entrance exams. She would be tested on Latin, Greek, and math, all subjects she didn't learn in high school. For eight months, she woke up before dawn to study. She aced the exams. For the next six years, she learned to care for patients and studied the **nervous system**. She also dated a fellow student, Germano Rondolini. She graduated in 1936 at age twenty-seven. Her story was about to collide with history.

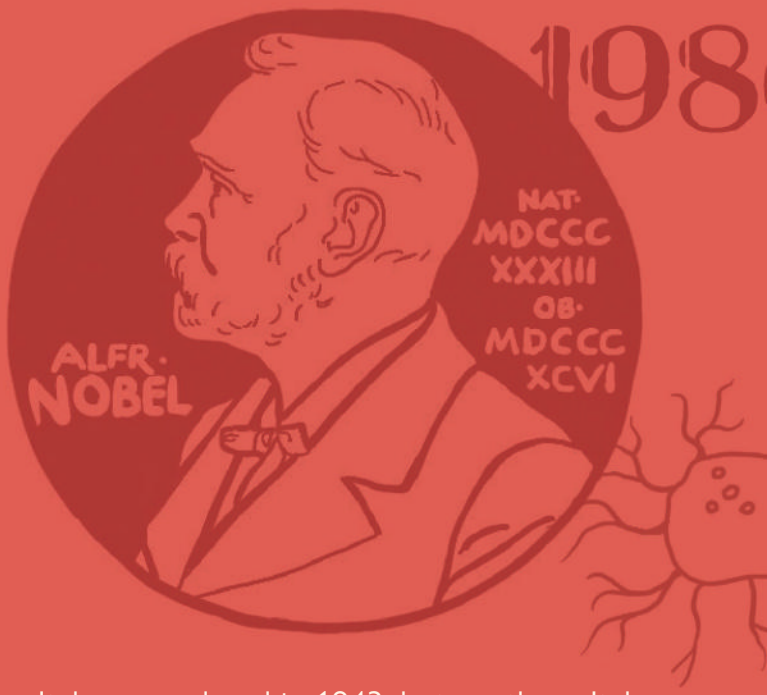
In 1938, Europe was on the brink of World War II. Italy's leader, Benito Mussolini, supported Nazi Germany. He made a law that barred Jews from many jobs, including working as doctors or scientists. He also made it illegal for Jews to marry non-Jews. Germano was not Jewish. Rita could not get a job in Italy or marry Germano. So, Rita found a job in Belgium researching **nerves**. Germano wrote to her every day. But sadly, within months he died from **tuberculosis**.

Another tragedy soon followed. Germany invaded Belgium in 1940. To escape Nazi **persecution** of Jews, Rita returned home. She found the situation in Italy "becoming everyday darker and more threatening." Trapped in her home with little to do, she set up a makeshift lab in her bedroom. She continued her study of nerves using what she could get without raising suspicions – chicken eggs. Often, she used the chick **embryo** for her experiments and the rest of the egg for her lunch. She made important discoveries about how nerve cells grow.

1940

Later in 1940, Italy officially entered the war. Bombings began in Turin. The risks for Jews increased. Rita and her family fled, first to the countryside and then to Florence. Using false identities, they hid their Jewish heritage. Rita made fake documents to protect her family and friends. If she had been caught, she could have been jailed or executed. Surrounded by danger, she kept at her research. By sending her findings outside of Italy, she even published some of her discoveries.





Italy surrendered in 1943, but northern Italy remained under German control. It wasn't until 1944 that Rita and her family could come out of hiding. She worked as a doctor in a refugee camp. Meanwhile, some of her war-time research caught the attention of a well-known scientist in America. He invited Rita to work with him at Washington University in St. Louis, Missouri.

Rita's 15 years at Washington University were a high point in her story. She called them the "most productive and happy period of my life." There, Rita made her most famous discovery. She put cells from **tumors** into the nerves of chick embryos. She then compared those nerves with normal nerves. The nerves with tumor cells grew up to 10 times more rapidly. She realized the tumor cells were producing a

USA

protein that caused the stunning growth. She called it nerve growth factor. The discovery helped scientists understand normal cell growth as well as many diseases like cancer and Alzheimer's. In 1986, the Nobel Prize for Medicine honored her breakthrough.

Rita eventually returned to Italy, where she did great science well into her 90s. As the founder of two research institutes, she mentored younger scientists, especially women. Her life showed, better than any movie could, an example of a person who fought for the "freedom to choose our own future, whatever may be our social status and sex." She died in 2012 at age 103.

Glossary

Embryo: :An animal or person in the very earliest stages of developing, before being born or hatched

Nerves: :Tissues in the body of an animal or person that carry messages between the brain and other parts of the body

Nervous system: :A network in the body of an animal or person that includes all its nerves and brain

Persecution: :Unfair or cruel treatment usually due to race, religion, or political beliefs

Tuberculosis: :A disease of the lungs caused by a specific kind of bacteria

Tumors: :An abnormal mass of tissue within the body; some tumors are caused by cancer

What Do Oncologists Do?

Cancer is a super hard disease to treat. This is because cancer can be caused by a wide variety of factors. From habits like smoking and drinking to chance influences like genes and mutations, many things can cause it.

Oncologists are health-care professionals who treat cancers.

Cancer isn't just one disease, either. Rather, cancer refers to a whole group of diseases. There isn't a one-size-fits-all treatment for cancers. Instead, each cancer needs a custom-made game plan to fully eradicate it. Cancer treatments have come a long way in recent years. Similarly, research into new treatments also continues to advance. For example, new treatments stimulate the immune system. Doctors and researchers work hard to develop new therapies every day. It takes a team of superheroes to fight a group of super diseases. Let's find out who these heroes are.

Who is an oncologist?

An oncologist is a doctor who specializes in cancer. They do everything related to cancer, from researching it to diagnosing it to treating it. The earliest oncologists can be traced back to Ancient Greece and Rome. Ancient doctors who studied cancer described it as a crab with outstretched legs. They reasoned that the spread of cancer was similar to how crabs walk.

Fast-forward to today, and there are oncologists for every type of cancer.

What do oncologists do?

Diagnosing cancer is an important part of an oncologist's job. They do this by first talking to their patients. Next, they look at their patients' medical history. Finally, they draw their conclusions after doing a physical exam.

Oncologists also keep track of their patients' treatment. They must manage what happens after. This includes seeing how their patients respond to treatment and medication. They have to watch for any side effects. These side effects can either be short term or long term. They also have to give their patients emotional support. Afterwards, oncologists must also help plan for the patients' long-term care. This could include regular check-ups and lifestyle changes.

So, oncologists end up forming long term relationships with their patients.

Who do oncologists work with?

Oncologists do not work in isolation. Beating cancer is a team effort. To achieve this, a variety of medical experts work together. Many types of healthcare workers can all specialize in **oncology**. For example, let's consider oncology nurses.

Oncology nurses are integral in helping both oncologists and patients. They help with executing treatment plans and dispensing medications. They keep a close watch on patients and look out for any changes. This extra information helps doctors create the best treatment plans for their patients.

All of them have the same goal. All oncologists want to give their patients the best care and treatment they can.

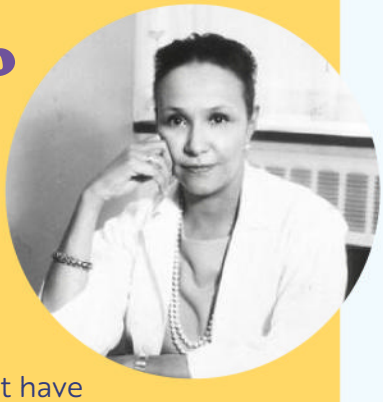
For example:

Pediatric oncologists treat children.

Gynecologic oncologists treat cancers that occur in women.

Oncologists also do cancer research. They look for new treatments and therapies to help people living with cancer. They also find new medicines and new ways to detect and prevent cancer. Most oncologists conduct research simultaneously with their practice.

Famous Women Who Shaped Oncology



In 1964, the American Society of Clinical Oncology was founded in Chicago. Of all the seven founders in the room, **Dr. Jane Wright** was the only woman. Yet, she might have had one of the most significant impacts on society. Dr. Wright was a trailblazer in the field of oncology. She was a woman of color who came from a well-respected medical lineage. In fact, her father was among the first African Americans to graduate from Harvard Medical School.

Dr. Wright was a pioneer in the field of cancer drugs. She created new treatments that have saved many lives. She was also the first female president of the New York Cancer Society. During her 40-year career in medicine, she wrote almost 100 papers on cancer and **chemotherapy**. She retired as one of the leading experts in her field.

Dr. Jimmie Holland is another famous health care expert. She was a pioneer in both psychology and oncology. She launched the study of psycho-oncology. In fact, she was a **psychiatrist** by profession!

Dr. Holland focused on the mental effects of cancer on a patient. She was even the editor of the world's first textbook devoted to this subject! She also founded the American Psychological Oncology Society. Her awareness and care towards the "human side" of cancer helped distinguish her from her peers.

How can you become an oncologist?

If you want to become an oncologist, you need a bachelor's degree. Undergraduate students may take foundation courses like organic chemistry or anatomy. These courses help students get a head start for medical college.

To get in, they have to take the Medical College Admissions Test (MCAT). Students can either opt for an M.D. or a D.O. An M.D. refers to a Doctor of Medicine degree, while a D.O. refers to a Doctor of Osteopathic Medicine. After getting in, getting an M.D. or a D.O. usually takes four more years.

After eight hard years, medical students finally get that coveted title. They're now proper doctors!

But before they can practice medicine, they must clear a residency program. During residency, doctors must choose their field of medicine. It is at this stage that doctors may specialize in oncology. So, if you want to be an oncologist, you have a long road ahead of you. You'll need to complete an oncology residency program. This program can last anywhere from two to five years.

After the years of residency, residents have one final hurdle. They will have to pass the Medical Licensing Exam. After getting through the exam, residents transition to attending oncologists. They can then practice as independent oncologists.

Credit: National Library of Medicine via Wikimedia Commons

Credit: NIH via Wikimedia Commons

Glossary:

Cancer:
A disease in which affected or abnormal cells grow and divide uncontrollably.

Chemotherapy:
A type of cancer treatment that aims to fight cancer using different types of chemical substances or drugs.

Psychiatrist:
A doctor who specializes in mental illnesses as opposed to physical illnesses.

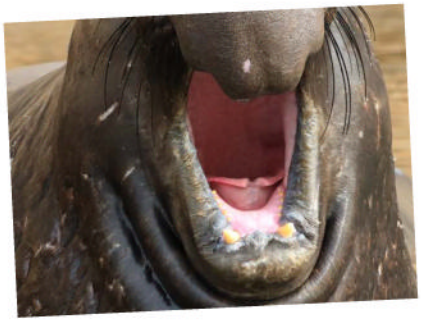
Radiologist:
A doctor or technician who specialises in using different types of radiation imaging technologies to help diagnose injuries or diseases.

Pathologist:
A medical professional who specializes in the identification of the body's tissues and fluids. They help diagnose diseases.

Oncology:
The study of cancer.

Guess what?

1 THIS SEAL IS KNOWN FOR ITS PROBOSCIS, AND IT IS THE PROBOSCIS THAT GIVES IT THE COMMON NAME IT HAS.



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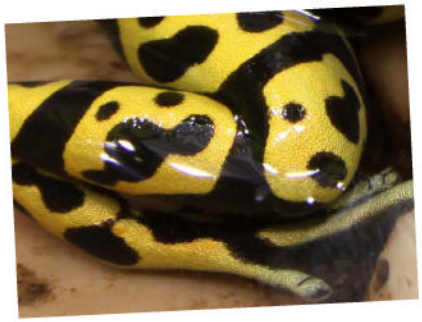
2 THESE BRIGHTLY-COLORED FROGS ARE POISONOUS, AND THEIR BRIGHT COLORS ARE SEEN AS A WARNING SIGN BY ANIMALS THAT MAY CHOOSE TO PREY ON THEM.



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3 THESE BIRDS HAVE LONG AND LARGE COLORFUL BEAKS THAT CAN BE FOUR TIMES THE SIZE OF THEIR HEAD.

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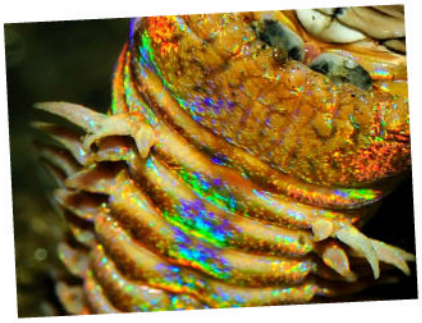
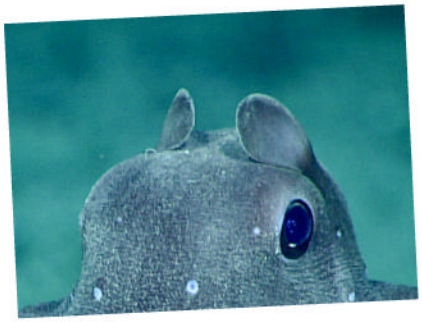
Credit: Charles J. Sharp via Wikimedia Commons Credit: Holger Krisp via Wikimedia Commons Credit: Grendelkhan via Wikimedia Commons

4 THESE ANIMALS HUNT IN PACKS AND EVEN COMPETE WITH LIONS FOR FOOD

5 THIS WORM LURKS UNDER THE SEA BED AND PREYS UPON UNSUSPECTING FISH OR MARINE ANIMALS WITH ITS POWERFUL JAWS.



6 THIS OCTOPUS LIVES IN THE GREATEST DEPTHS OF THE OCEAN, ALMOST 13,000 FEET BELOW THE WATER'S SURFACE.



Credit: NOAA Ocean Exploration & Research from USA via Wikimedia Commons Credit: Jenny via Wikimedia Commons Credit: Acediscovery via Wikimedia Commons

Bioluminescent Algae

Only ten percent of the ocean has been explored. It is full of mystery and surprises, with beauty at every depth. One mysterious sight in the ocean is bioluminescent algae. ***Bioluminescence*** *is when an organism glows or shines a bright light.*

Fireflies are a great example of a bioluminescent organism. Even though they are very different from algae, they shine in a similar way, lighting up the sky as they glow.

Algae *are organisms that can live in the water and make their own food through photosynthesis like plants do. They can be made of one single cell or have many cells. These tiny organisms have many important jobs and are important to the global food chain.*

Credit: Trevor McKinnon on Unsplash

Chemical reactions include **reactants** and **products**. Reactants are chemicals that work together to make products, which are the result of a reaction.

HOW DO BIOLUMINESCENT ALGAE GLOW?

Bioluminescence is caused by a chemical reaction involving **luciferin** and **luciferase**. Luciferase is an enzyme, which means it causes a chemical reaction to happen more easily. Luciferase helps the luciferin reactant to work with other chemicals and make light as a product. But why do algae need this glowing chemical reaction?

WHAT IS AN ENZYME?

Imagine you are blindfolded and asked to walk across a room and turn on a light. This might be easier to do if someone came to hold your hand and walk you in the right direction. The person holding your hand is like an enzyme. The enzyme helps to speed up a chemical reaction.

WHY DO ALGAE GLOW?

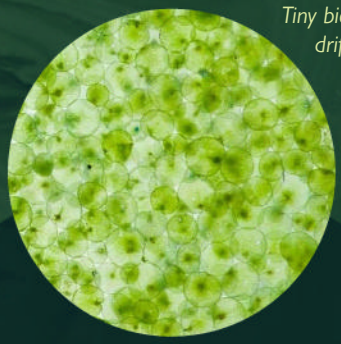
Glowing algae is a signal that something is wrong in the water. This chemical reaction that causes a blue-green glimmer happens when algae is disturbed. Algae is very low on the food chain. When predators attempt to consume algae, bioluminescence comes to the rescue.

An algal bloom in the Baltic Sea

Groups of algae can come together and form **blooms**, making a bright blue light in the water at night. Bioluminescence has two main jobs during this time. First, it alerts larger predators to come eat the smaller predators that are disturbing the algae. Next, the algae is toxic to eat. This means that if predators eat enough of the algae, they can get very sick. The bright light is a signal to these predators not to eat the algae for their own safety.

WHY DO WE NEED ALGAE?

It is a good thing that algae can protect themselves through bioluminescence, because algae is extremely important to the environment. It is a food source for many predators, but it also has a very important job. Algae remove carbon dioxide from the atmosphere through photosynthesis, just like plants do. However, algae remove 10–50 times more carbon dioxide than plants. They are environmental warriors, and it's important that they remain protected and healthy.



Tiny bioluminescent drifters

Credit: Abhishek Jamalabad @sea_coocoomber via Instagram

As climate change continues to become a threat and carbon dioxide levels rise in the environment, it is actually easier to spread algae than it is to grow plants.

For this reason, algae are becoming a key tool to fight climate change and clean up the air that we breathe.

WHERE IS BIOLUMINESCENT ALGAE FOUND?

These glowing organisms can be seen all around the world. We know that algae can glow when they are threatened, but algae can also glow if the water saltiness changes or if the climate changes. In some regions of the world, bioluminescent algae glows the most in the summer. In some regions, it can glow all year long.

Credit: Mihály Kóles on Unsplash

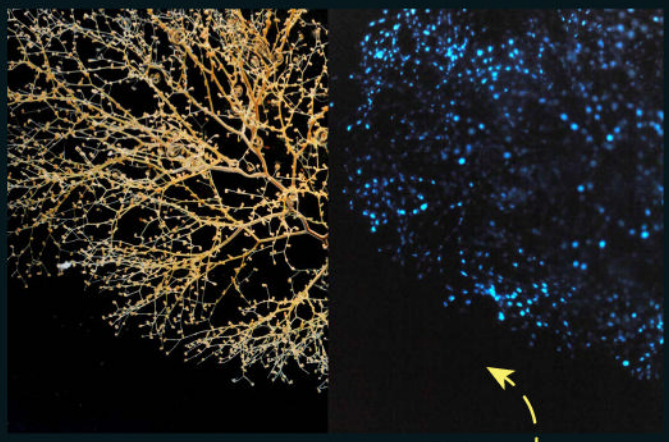
PRO TIP

Some of the best places to see bioluminescent algae are in enclosed bodies of water like bays, where algae cannot easily escape into the ocean.

IS IT SAFE TO SWIM WITH BIOLUMINESCENT ALGAE?

Even though it might be tempting to go into those glowing waters, scientists say it is not the safest idea. Remember that algae are **toxic** to their predators. That blue-green glow is a defense mechanism to keep predators away, and humans should also steer clear. If you really cannot resist getting closer, some glowing algae bays have kayaking tours to go out on the water and watch the algae shine around you. If the algae are not around to show off their glow, other organisms may be able to put on a show, too.

Bioluminescent starfish



Chrysogorgia coral under regular white light (left) and with bioluminescence (right).

DO OTHER ORGANISMS GLOW?

Tiny algae are not the only organisms that glow. In fact, up to 76% of ocean organisms have bioluminescence, including jellyfish and sea stars. Organisms of all shapes and sizes glow for different reasons. Like algae, they can use it as a defense mechanism. But some organisms use their glow-y powers to help find mates! Bright lights serve many purposes in the mysterious ocean.

Credit: NOAA Bioluminescence and Vision on the Deep Seafloor 2015.

How is bioluminescence used in scientific laboratories?

One more unexpected use for bioluminescence happens in scientific laboratories. Scientists can create cells that make luciferase and produce bioluminescent light during specific conditions. These cells are used by scientists who study all different kinds of diseases, from cancer to viral infections. Who knew that a bioluminescent glow could be such a useful tool to scientific discovery?

***Aequorea victoria**, also sometimes called the crystal jelly, is a bioluminescent hydrozoan jellyfish*

Bioluminescent Beach

Credit: Ahmed Nishaath via Unsplash

Credit: Sierra Blakely via Wikimedia Commons

Glossary

Bioluminescence :When an organism makes a glowing light

Algae :Organisms that live in the water and use photosynthesis to make food
Can be single or multicellular

Reactants :Chemicals that work together to make a product in a chemical reaction

Product :The result of a chemical reaction

Luciferin and Luciferase :Key pieces of a chemical reaction that makes bioluminescence

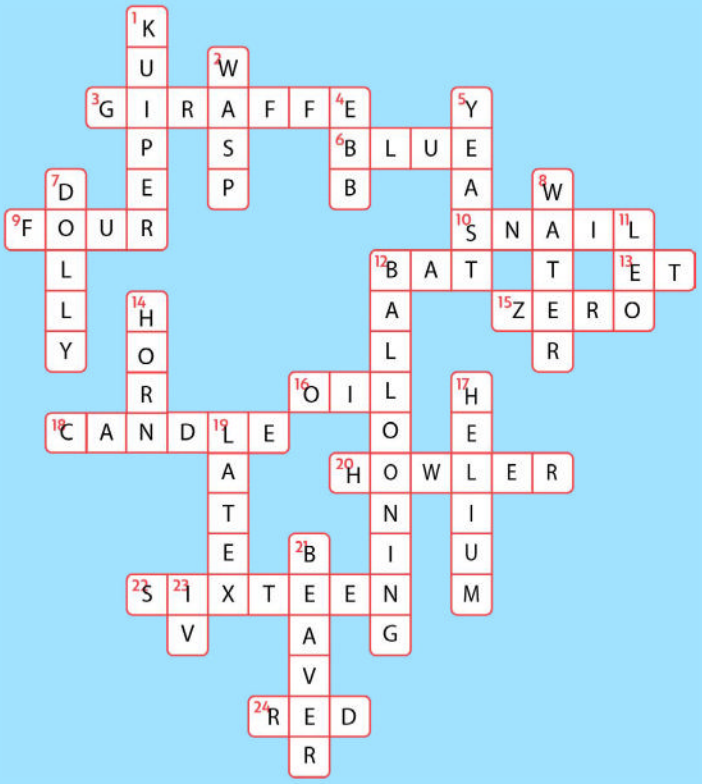
Blooms :Groups of algae

Toxic :Poisonous when too much is eaten or ingested

Mind Muddlers

1. **(D) Ozone:** Only once did all countries on earth agree on something. In 1988, all 198 countries in the United Nations agreed to the terms and ratified the Montreal Protocol. The objective was to regulate the production and usage of substances that could deplete ozone (e.g.: chlorofluorocarbons). Depletion of ozone makes the planet vulnerable to UV rays, which can significantly increase the risks of cancer. This agreement was a milestone in human history.
2. **(B) Antipyretic:** Fever itself is not a disease. It is an immune response meant to kill pathogens that have invaded the body. Many diseases are cured faster and do less damage when fever is allowed to persist.
3. **(A) Smog:** In 1952, London faced a catastrophic smog, named The Great Smog. It led to the death of around 4000 people. Most of the cases were due to hypoxia (lack of oxygen), bronchitis, and pus accumulating in the lungs.
4. **(C) Fermentation:** Fermentation is mostly seen in microbial metabolism. However, higher organisms, like humans, also perform fermentation. When a person performs strenuous exercise, fermentation occurs in the muscle. This leads to the formation of lactic acid. Lactic acid causes muscle pain, which can be relieved by sufficient rest.
5. **(D) Nitrogen:** Nitrogen is one of the most important components for sustaining biological systems. It is a major component of DNA. It is also present in all proteins, and is very important for the synthesis of hormones and enzymes, which are mostly proteins.
6. **(A) Table salt:** Table salt forms lumps during a monsoon. This is not an inherent property of salt. Impurities, like chlorides of calcium and magnesium, absorb water from the atmosphere, forming lumps with salt particles.
7. **(B) Mercury:** Mercury is a toxic metal. Industrial wastewater contains mercury compounds. When this wastewater meets a large body of water, it contaminates fish and shellfish. Humans that consume these fish get affected by Minamata disease, which causes neurological troubles. Severe outbreaks of Minamata disease occurred in Japan during the 1950s and 1960s.
8. **(C) Hemoglobin:** Hemoglobin is a cluster of four molecules that can bind to oxygen. The first molecule of oxygen takes a huge amount of time to bind to hemoglobin. The last oxygen molecule binds almost 300 times faster than the first one. This method of binding oxygen to hemoglobin is known as cooperative binding.
9. **(C) Spherical:** Rainwater is the purest form of natural water, with very few impurities.
10. **(C) Quartz:** Quartz is an interesting and very important material in the world of electronics. When force is applied to quartz, it starts to accumulate an electrical charge. This property of a substance is called piezoelectricity. It is used in pressure sensors, sonar equipment, and alarm clocks.

Crossword



Guess What?

#1 Elephant seal
#2 Poison dart frog
#3 Toucan
#4 African wild dog
#5 Bobbit worm
#6 Dumbo octopus

smore

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